

Claims

1. A spread OFDM wireless communication system (100) comprising:
- 5 at a transmitter (110-140)
means for transmitting a spread OFDM signal;
at a receiver (160-180)
means for receiving the spread OFDM signal;
means for equalizing the spread OFDM signal
10 means for splitting the equalized spread OFDM
signal into a first plurality of portions
including a first portion and a second portion;
means for making a decision on the second
portion to produce a decided second portion;
15 means for subtracting the decided second
portion from the received spread OFDM signal to
produce a first difference signal; and
means for equalising and processing the first
difference signal to recover the first portion
20 of the received signal in which interference
due to second portion interfering terms is
substantially reduced.
2. The system of claim 1 further comprising:
- 25 at the receiver (160-180)
means for making a decision on the first
portion to produce a decided first portion;
means for subtracting the first portion from
the equalised spread OFDM signal to produce a
30 second difference signal; and

means for equalising and processing the second difference signal to recover the second portion of the received signal in which interference due to first portion interfering terms is substantially reduced.

3. The system of claim 2 wherein the receiver (160-180) further comprises means for repeating processing a predetermined number of further times, with the recovered first and second portions in place of the decided first and second portions, to recover more reliable estimates for the first and second portions.

4. The system of claim 1, 2 or 3 further comprising:
at the receiver (160-180)
means for splitting the recovered received signal into a second plurality of portions greater in number than the first plurality of portions and including a first subsequent portion, a second subsequent portion, a third portion and a fourth portion;
means for subtracting the second subsequent portion, the third portion and the fourth portion from the received signal to produce a first subsequent difference signal; and
means for processing the first subsequent difference signal to recover the first subsequent portion of the recovered received signal in which interference due to second, third and fourth portion interfering terms is substantially reduced;

means for making a decision on the first
subsequent portion to produce a decided first
subsequent portion;

5 means for subtracting the first subsequent
portion, the third portion and the fourth
portion from the received signal to produce a
second subsequent difference signal; and
means for processing the second subsequent
10 difference signal to recover the second
subsequent portion of the recovered received
signal in which interference due to first,
third and fourth portion interfering terms is
substantially reduced;

15 means for making a decision on the second
subsequent portion to produce a decided second
subsequent portion;

means for subtracting the first subsequent
portion, the second subsequent portion and the
fourth portion from the received signal to
20 produce a third difference signal;

means for processing the third difference
signal to recover the third portion of the
recovered received signal in which interference
25 due to first, second and fourth portion
interfering terms is substantially reduced;

means for making a decision on the third
portion to produce a decided third portion;

means for subtracting the first subsequent
portion, the second subsequent portion and the
30 third portion from the received signal to
produce a fourth difference signal;

means for processing the fourth difference
signal to recover the fourth portion of the
recovered received signal in which interference
due to first, second and third portion
5 interfering terms is substantially reduced; and
means for making a decision on the fourth
portion to produce a decided fourth portion.

5. The system of claim 4 wherein the receiver (160-180)
10 further comprises means for repeating processing a
predetermined number of further times, with the decided
first subsequent portion, the decided second subsequent
portion, the decided third portion and the decided fourth
portion in place of the recovered first subsequent
15 portion, the recovered second subsequent portion, the
recovered third portion and the recovered fourth portion
respectively, to recover more reliable estimates for the
first subsequent portion, the second subsequent portion,
the third portion and the fourth portion.

20

6. The system of claim 4 wherein the second plurality
of portions is an integer multiple of 2 that is greater
than 2.

25 7. The system of any preceding claim wherein the means
for equalising and processing comprises:
first matrix multiplication means for multiplying by
a first diagonal matrix having elements dependent on
channel coefficients; and

second matrix multiplication means for multiplying
by a second matrix which is a subset of a Walsh
Hadamard matrix.

5 8. The system of any preceding claim wherein the means
for equalising and processing comprises means for
performing minimum mean square error equalization.

9. The system of any preceding claim wherein the means
10 for transmitting a spread OFDM signal comprises means for
spreading by performing a Walsh Hadamard transform.

10. A spread OFDM wireless communication system (100)
comprising:

at a transmitter (110-140)

means for transmitting a spread OFDM signal;

5 at a receiver (160-180)

means for performing minimum mean square error
equalization having:

first matrix multiplication means for
multiplying by a first diagonal matrix
10 having elements dependent on channel
coefficients; and

second matrix multiplication means for
multiplying by a second matrix which is a
subset of a Walsh Hadamard matrix.

15

11. A receiver (160-180) for use in a spread OFDM wireless communication system (100), the receiver comprising:

5 means for receiving a wireless spread OFDM signal;
means for equalizing the spread OFDM signal
means for splitting the equalized spread OFDM signal into a first plurality of portions including a first portion and a second portion;
10 means for making a decision on the second portion to produce a decided second portion;
means for subtracting the decided second portion from the received spread OFDM signal to produce a first difference signal; and
15 means for equalising and processing the first difference signal to recover the first portion of the received signal in which of interference due to second portion interfering terms is substantially reduced.

20

12. The receiver of claim 11 further comprising:

means for making a decision on the first portion to produce a decided first portion;
means for subtracting the first portion from
25 the equalised spread OFDM signal to produce a second difference signal; and
means for equalising and processing the second difference signal to recover the second portion of the received signal in which interference
30 due to first portion interfering terms is substantially reduced.

13. The receiver of claim 12 wherein the receiver further comprises means for repeating processing a predetermined number of further times, with the recovered
5 first and second portions in place of the decided first and second portions, to recover more reliable estimates for the first and second portions.

14. The receiver of claim 11, 12 or 13 further
10 comprising:

means for splitting the recovered received signal into a second plurality of portions greater in number than the first plurality of portions and including a first subsequent
15 portion and a second subsequent portion, a third portion and a fourth portion;
means for subtracting the second subsequent portion, the third portion and the fourth portion from the recovered received signal to
20 produce a first subsequent difference signal;
and

means for processing the first subsequent difference signal to recover the first
subsequent portion of the recovered received
25 signal in which interference due to second, third and fourth portion interfering terms is substantially reduced;
means for making a decision on the first
subsequent portion to produce a decided first
30 subsequent portion;

means for subtracting the first subsequent portion, the third portion and the fourth portion from the received signal to produce a second subsequent difference signal;

5 means for processing the second subsequent difference signal to recover the second subsequent portion of the recovered received signal in which interference due to first, third and fourth portion interfering terms is substantially reduced;

10 means for making a decision on the second subsequent portion to produce a decided second subsequent portion;

means for subtracting the first subsequent portion, the second subsequent portion and the fourth portion from the received signal to produce a third difference signal;

15 means for processing the third difference signal to recover the third portion of the recovered received signal in which interference due to first, second and fourth portion interfering terms is substantially reduced;

20 means for making a decision on the third portion to produce a decided third portion;

25 means for subtracting the first subsequent portion, the second subsequent portion and the third portion from the received signal to produce a fourth difference signal;

30 means for processing the fourth difference signal to recover the fourth portion of the recovered received signal in which interference

due to first, second and third portion
interfering terms is substantially reduced; and
means for making a decision on the fourth
portion to produce a decided fourth portion.

5

15. The receiver of claim 14 further comprising means
for repeating processing a predetermined number of
further times, with the decided first subsequent portion,
the decided second subsequent portion, the decided third
10 portion and the decided fourth portion in place of the
recovered first subsequent portion, the recovered second
subsequent portion, the recovered third portion and the
recovered fourth portion respectively, to recover more
reliable estimates for the first subsequent portion, the
15 second subsequent portion, the third portion and the
fourth portion.

16. The receiver of any one of claims 11-15 wherein the
means for equalising and processing comprises:

20 first matrix multiplication means for multiplying by
a first diagonal matrix having elements dependent on
channel coefficients; and
second matrix multiplication means for multiplying
by a second matrix which is a subset of a Walsh
25 Hadamard matrix.

17. The receiver of any one of claims 11-16 wherein the
means for equalising and processing comprises means for
performing minimum mean square error equalization.

30

18. A receiver (160-180) for use in a spread OFDM wireless communication system, the receiver comprising:
means for performing minimum mean square error equalization having:

- 5 first matrix multiplication means for
multiplying by a first diagonal matrix having
elements dependent on channel coefficients; and
second matrix multiplication means for
multiplying by a second matrix which is a
10 subset of a Walsh Hadamard matrix.

19. A method of operating a receiver (160-180) in a spread OFDM wireless communication system (100), the method comprising:

5 receiving a wireless spread OFDM signal;
 equalizing the spread OFDM signal
 splitting the equalized spread OFDM signal into
 a first plurality of portions including a first
 portion and a second portion;
 making a decision on the second portion to
10 produce a decided second portion;
 subtracting the decided second portion from the
 received spread OFDM signal to produce a first
 difference signal; and
15 equalising and processing the first difference
 signal to recover the first portion of the
 received signal in which of interference due to
 second portion interfering terms is
 substantially reduced.

20 20. The method of claim 19 further comprising:
 making a decision on the first portion to
 produce a decided first portion;
 subtracting the first portion from the
 equalised spread OFDM signal to produce a
25 second difference signal; and
 equalising and processing the second difference
 signal to recover the second portion of the
 received signal in which interference due to
 first portion interfering terms is
30 substantially reduced.

21. The method of claim 20 further comprising repeating processing a predetermined number of further times, with the recovered first and second portions in place of the decided first and second portions, to recover more
5 reliable estimates for the first and second portions.

22. The method of claim 19, 20 or 21 further comprising:
splitting the recovered received signal into a
second plurality of portions greater in number
10 than the first plurality of portions and
including a first subsequent portion and a
second subsequent portion, a third portion and
a fourth portion;
subtracting the second subsequent portion, the
15 third portion and the fourth portion from the
recovered received signal to produce a first
subsequent difference signal; and
processing the first subsequent difference
signal to recover the first subsequent portion
20 of the recovered received signal in which
interference due to second, third and fourth
portion interfering terms is
substantially reduced;
making a decision on the first subsequent
25 portion to produce a decided first subsequent
portion;
subtracting the first subsequent portion, the
third portion and the fourth portion from the
received signal to produce a second subsequent
30 difference signal;

processing the second subsequent difference
signal to recover the second subsequent portion
of the recovered received signal in which
interference due to first, third and fourth
5 portion interfering terms is substantially
reduced;
making a decision on the second subsequent
portion to produce a decided second subsequent
portion;
10 subtracting the first subsequent portion, the
second subsequent portion and the fourth
portion from the received signal to produce a
third difference signal;
processing the third difference signal to
15 recover the third portion of the recovered
received signal in which interference due to
first, second and fourth portion interfering
terms is substantially reduced;
means for making a decision on the third
20 portion to produce a decided third portion;
means for subtracting the first subsequent
portion, the second subsequent portion and the
third portion from the received signal to
produce a fourth difference signal;
25 processing the fourth difference signal to
recover the fourth portion of the recovered
received signal in which interference due to
first, second and third portion interfering
terms is substantially reduced; and
30 making a decision on the fourth portion to
produce a decided fourth portion.

23. The method of claim 22 further comprising repeating processing a predetermined number of further times, with the decided first subsequent portion, the decided second
5 subsequent portion, the decided third portion and the decided fourth portion in place of the recovered first subsequent portion, the recovered second subsequent portion, the recovered third portion and the recovered fourth portion respectively, to recover more reliable
10 estimates for the first subsequent portion, the second subsequent portion, the third portion and the fourth portion.

24. The method of claim 22 wherein the second plurality
15 of portions is an integer multiple of 2 that is greater than 2.

25. The method of any one of claims 19-24 comprising:
multiplying by a first diagonal matrix having
20 elements dependent on channel coefficients; and
multiplying by a second matrix which is a subset of a Walsh Hadamard matrix.

26. The method of any one of claims 19-25 comprising
25 performing minimum mean square error equalization.

27. A method for performing minimum mean square error equalization in a spread OFDM wireless communication system (100), the method comprising:

- 5 multiplying by a first diagonal matrix having elements dependent on channel coefficients; and
- multiplying by a second matrix which is a subset of a Walsh Hadamard matrix.